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Art. X.—*A Revision of the Nomenclature of the Permian Foraminifera of New South Wales.*

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Introduction.

So long a period has elapsed since the publication of the "Monograph of the Foraminifera of the Permocarboniferous Limestone of New South Wales" by two of the present authors (Chapman and Howchin, 1905), and such great advances in our knowledge of Upper Palaeozoic foraminifera have been made in recent years, that, as a preliminary to further work on the Permian of Australia, it has been necessary to revise the determinations given in 1905. In this revision, which we now submit, we have not attempted to add to the list of forms recorded previously, although further material from Pokolbin has been examined with the object of settling several doubtful points. Correlative notes on published occurrences elsewhere in Australia are given, and the species referred to their accepted genera.

Although in the former publication the two foraminiferal horizons dealt with were referred to as in the Permocarboniferous system, in the latest note on the subject by Professor Sir T. W. Edgworth David and Mr. Süssmilch, they are now regarded as of Permian age; the beds at Pokolbin being placed in the Lower Permian, and those at Wollong in the Middle Permian. The Pokolbin foraminiferal horizon is very closely comparable with that of Fossil Cliff, Irwin River, in Western Australia, which is also included in the Lower Permian by the authors named.

In recent publications on the Upper Palaeozoic foraminifera, many new genera have been described, and a better understanding of the structure and relationships of a number of forms has also been gained. Much work, however, yet remains to be done, particularly in regard to the character of the shell-wall of several genera, before their positions can be satisfactorily settled. As three of them, viz., *Monogenerina, Geinitzina,* and *Spandelina* (including its sub-genus *Spandelinoides*) appear to have been recorded under these or other generic names, from the Permian rocks of New South Wales, it is deemed advisable to make some comments on these genera before proceeding with the revision and the systematic notes on the species.

Notes on the Genera Monogenerina, Spandelina (including Spandelinoides) and Geinitzina.

Genus **Monogenerina** Spandel, 1901.

This genus was described by Spandel (1901, p. 181) from the Permocarboniferous of Hooser, Kansas, U.S.A., with two species, *M. atava,* the genotype, and *M. nodosariaeformis,* both based on sections of specimens in silicified limestone. While Spandel was uncertain as to whether the shell-wall was sandy or calcareous, he placed the genus between *Bigenerina* and *Textularia,* and stated that the chambers and the aperture had the form characteristic of those in *Bigenerina.* He mentions he was unable to see any pores in the shell of *M. atava.*

Cushman (1933, p. 110), in the second edition of his "Foraminifera," describes the wall as finely arenaceous, with much cement and a thin outer covering, and groups the genus with the Textulariidae. Galloway (1933, p. 168), on the contrary, states that the walls are finely fibrous or finely granular, or with fibrous inner layer and granular outer layer, not arenaceous. He includes *Spandelinoides* Cushman and Waters, in the synonomy of *Monogenerina,* which he places in the family Nodosinellidae.

Without an opportunity of examining the type species of *Monogenerina* and *Spandelinoides,* we can only base our opinion as to their relationships on published descriptions and figures, and on our knowledge of Palaeozoic faunas. It appears to us that *Monogenerina* is one of the group of *Cribrostomum* Möller, *Climacammina* Brady, *Deckerella* Cushman and Waters, and *Cribrogenerina* Schubert. The large aperture and the general form strongly suggest to us, as they did to Spandel and Cushman, a relationship with the Textulariidae. They are quite different from those of *Spandelinoides,* which we discuss later under *Spandelina.* Since we regard *Monogenerina* as having an agglutinated test, the species described by two of us as *M. pyramidis,* from Pokolbin, New South Wales, is now transferred to *Nodosaria,* as the wall is hyaline and perforate.

Genera **Geinitzina** and **Spandelina** (including sub-genus **Spandelinoides**).

In view of the generally accepted family relationship of *Geinitzina, Spandelina,* and *Spandelinoides,* it seems to be advantageous to discuss them together. We will first give the history of each, its genotype, salient characters, geological and geographical distribution, and then consider the position of the three.

Genus **Geinitzina** Spandel, 1901.

This genus was originally described by Spandel (1898, p. 7), as *Geinitzella* from the Zechstein of Germany. This name was found to be preoccupied, and the genus was renamed by Spandel (1901, p. 189), in his paper on the foraminifera of the Permocarboniferous of Hooser, Kansas, United States of America. Spandel referred two species to *Geinitzella, Textularia cuneiformis* T. R. Jones and *G. acuta*, sp. nov., both of which he figured.

Subsequently, *Textularia cuneiformis* Jones was designated the genotype of *Geinitzina* by Cushman. As Galloway, following Jones and H. B. Brady, considers *T. cuneiformis* to be biserial, he restricts *Geinitzina* to this and similar biserial species, and places other described species of *Geinitzina* in *Spandelina*. In doing so, he makes (*loc. cit.*) the following observations:—"It is very unfortunate that Cushman designated *Textularia cuneiformis* Jones as the genotype of *Geinitzina*, thereby changing the definition of that genus from a uniserial form, as intended by Spandel, to a biserial form."

This does not necessarily follow, as the genus must rest on Spandel's type material.. As Spandel described and figured both species of *Geinitzella* as uniserial, therefore *Geinitzina*, if used at all, must be restricted to uniserial forms, unless, as is exceedingly unlikely, the species he had were actually biserial.

After studying Jones's figure and description of *Textularia cuneiformis* (Jones, 1850, p. 18, pl. vi., fig. 6), which is at best an unsatisfactory species, we consider that the form figured by Spandel under this name was wrongly identified. In our opinion, Spandel's two figures represent the one species, *G. acuta;* either the differences between the two specimens are due to dimorphism, or, what appears more probable in the light of our experience of the Australian species, *G. triangularis* Chapman and Howchin, the two specimens are both megalospheric examples of the same species, with prolocula of different sizes.

The general characters of *Geinitzina* may be described as follows:—Test free, triangular in outline, much compressed, especially along the median line; chambers uniserial, in a rectilinear series, usually arched in the early stages, becoming more or less transverse in the mature shell; aperture generally elliptical, but in *G. ciscoensis* Cushman and Waters, it may be linear, and more or less zig-zag in shape.

The nature of the shell-wall in *Geinitzina* is of major importance in determining the position of the genus. Spandel by placing *Geinitzina* in the "Nodosaridae," interpreted it to be hyaline. Cushman (1933, p. 111), in his latest classification, states that it is finely arenaceous, with much cement and a thin outer layer when well preserved, and includes the genus in the

Textulariidae. Galloway (1933, pp. 164, 169, under *Spandelina*), describes the wall as calcareous, finely granular or fibrous, with the fibres at right angles to the surface of the test, possibly finely perforated. *Spandelina* is placed by him in the Nodosinellidae.

According to published records, *Geinitzina* occurs only in the Carboniferous and the Permian, and is often abundant in the latter. It has a wide geographical distribution, being known from Germany, United States of America, Australia, Japan, and Timor.

Genus **Spandelina** Cushman and Waters, 1928.

Spandelina and its sub-genus *Spandelinoides* were both originally described from the Upper Pennsylvanian-Lower Permian of Sutton County, Texas, United States of America (Cushman and Waters, 1928, pp. 363 *et seq.*). The genoholotype of *Spandelina* is *S. excavata* Cushman and Waters, and the subgenoholotype of *Spandelinoides, S.(S.) nodosariformis*, of the same authors.

Cushman (1933, p. 110), describes the genus as follows:— "Test uniserial, the chambers in a generally rectilinear series, the earlier ones at least compressed, especially in the microspheric form; wall calcareous, finely arenaceous, with a thin coating; aperture simple, terminal, elliptical or rounded. Without the thin outer covering, the wall of *Spandelina* appears perforate, especially when calcitized, as is common." He places it in the Textulariidae. In the original description of *Spandelina* and *Spandelinoides,* the wall was stated to be calcareous and perforate.

It will be noted that the above description embraces rounded as well as flattened forms, the former being placed in the subgenus *Spandelinoides,* which is apparently an isomorph of *Nodosaria*.

Galloway (1933, p. 169) considers the wall of *Spandelina* to be calcareous, finely granular or fibrous, and finely perforate. As we have said under *Monogenerina*, he gives a similar description of the shell-wall of *Spandelinoides,* except that no mention of its being perforate is then made. All three are included by him in the Nodosinellidae.

We may observe that Cushman and Waters described costate, as well as smooth, species of *Spandelina* and *Spandelinoides*. Costation is of very unusual occurrence in the other genera placed by Cushman in the *Textulariidae,* and in those included by Galloway in the Nodosinellidae. It is generally characteristic of the hyaline forms of foraminifera.

According to Cushman (1933, p. 110), *Spandelina* occurs in the Permian, and doubtfully in the Pennsylvanian, the only published records appear to be from North America.

Discussion on the Relationships of Geinitzina and Spandelina.

Comparison of the generic characters of *Geinitzina* and *Spandelina* (*sensu stricto*) will show that *Spandelina* has a proportionately more elongated test than *Geinitzina*, and the majority of the chambers are slightly arched. As in *Geinitzina*, each face may have a strong median groove, or may be flat, or even slightly concave. Galloway, as we have already remarked, considers the differences between the two are so slight as to justify the use of one genus only.

In general, the forms placed in *Geinitzina*, *Spandelina*, and *Spandelinoides* remind one strongly of the Nodosariidae; *Geinitzina* and *Spandelina* of *Frondicularia*, and *Spandelinoides* of *Nodosaria*. No trace of coiling has, however, been recorded in the genera under discussion. No figures of the early stages of the microspheric form of any of the species have been given. Cushman (1933, p. 11), however, states that the microspheric form of *Geinitzina* shows a trace of the biserial ancestry. Of *Spandelina*, he says (*op. cit.*, p. 110), that the microspheric form is compressed in the early chambers, but no mention of biseriality is made.

We have no personal knowledge of the type species of *Geinitzina and Spandelina* (including *Spandelinoides*), and are, therefore, placed at a disadvantage in considering the position of these genera. *Geinitzina* has, however, been recorded from the Permian of New South Wales by two of us (F. C. and W. H.), and there can be little doubt that the species included in the same work under the names of *Frondicularia woodwardi* Howchin, and *Nodosaria labiata* (Spandel) are of similar types of shell structure to the forms placed by Cushman and Waters in *Spandelina*.

Frondicularia woodwardi was described by Howchin (1895, p. 197, pl. x., figs. 4-6) from the "Permo-Carboniferous" of the Irwin River, in Western Australia, together with another new species, *Nodosaria irwinensis*, which closely resembles the costate forms placed in *Spandelinoides*. By the kindness of Professor E. de C. Clarke, of the University of Western Australia, we have a quantity of material from the same locality. This contains many exceptionally well preserved foraminifera, including, in addition to the species already mentioned, *Geinitzina triangularis*. As all three occur in considerable numbers, we have studied them carefully to see if they throw any light on the relationships of *Geinitzina* and *Spandelina*. Examples of each have been examined as opaque objects and in section, and the shell-wall has been studied under the petrological microscope.

In thin sections of the best preserved specimens, the wall is typically hyaline, but generally there has been an alteration in its character which, in such cases, is finely granular. This structure has been interpreted by some authors as evidence that the wall is

not hyaline, but we find exactly the same structure in some Upper Cretaceous examples of species of *Flabellina* and *Frondicularia*, from the Chalk of Gingin, Western Australia. Under crossed nicols, the delicate pinks and greens of calcite plates are visible.

The wall is closely and finely perforate, the tubules in *Geinitzina triangularis* measuring 0.0015 mm. in diameter.

Externally, the shell-wall in all three species is indistinguishable from that of fossil Nodosariidae; in *Frondicularia woodwardi* and *Geinitzina triangularis* the surface is polished.

The aperture in *Nodosaria irwinensis* is circular and terminal and situated at the base of a slight depression. It is not radiate, and is similar to that found in *Spandelinoides*. In *Frondicularia woodwardi* and *Geinitzina triangularis*, we have what does not appear to have been recorded in any other Palaeozoic foraminifer, a stellate aperture. This is weakly developed in some specimens; but, as a rule, is quite typical when the margin is regularly toothed and slightly exsert. In *G. triangularis* the aperture is elongate, and in *F. woodwardi* it is rounded. The apertural chamberlet described by Cushman (1928, pp. 22, *et seq.*) is absent from both species.

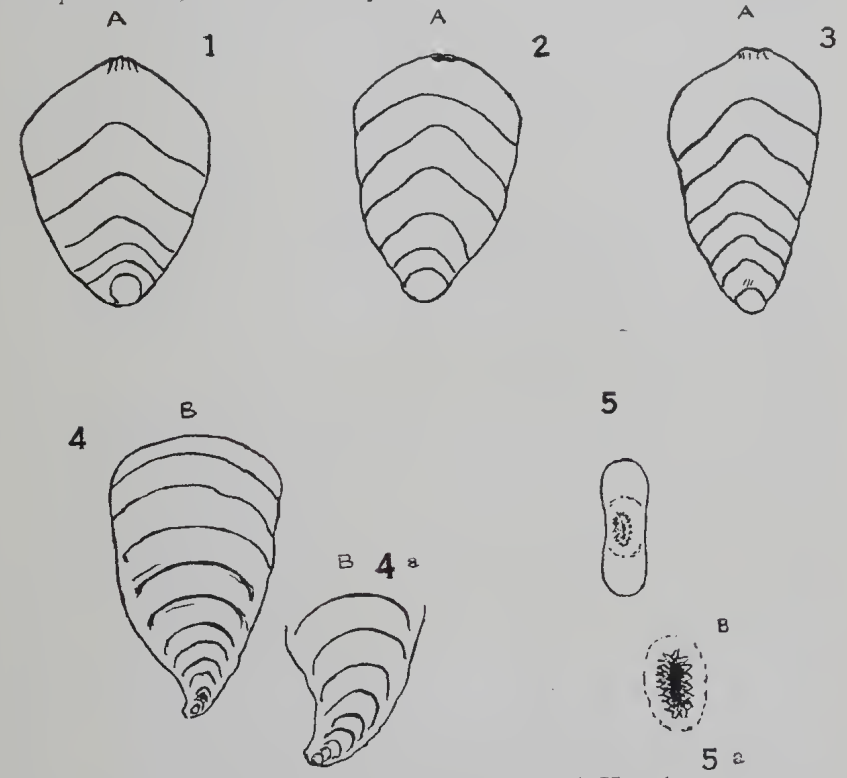
Amongst the specimens of *Geinitzina triangularis*, we were so fortunate as to find several examples of the microspheric form. These begin with a minute proloculum, measuring in the specimen figured 0.01 mm. in diameter, which is succeeded by a gently curved series of three or four chambers, gradually increasing in size. These in turn are followed by chambers similar to those seen in the megalospheric form. In no case are the chambers biserially arranged. We figure examples showing the arrangement of the chambers in Forms A and B.

In view of the above evidence, it appears to us that all three species were correctly placed in the genera under which they were described. *Frondicularia woodwardi* is typical of the genus. Except for the radiate aperture, *Geinitzina triangularis*, in its megalospheric form, is similar in generic characters to the species placed by Spandel in *Geinitzina*. The stellate aperture is, in our opinion, merely a development from the simple oval orifice of *G. acuta* (Spandel), an intermediate stage in its evolution being represented by the zig-zag slit seen in *G. ciscoensis* Cushman and Waters. Similarly, we believe that *Nodosaria irwinensis* is, despite the absence of a radiate aperture, a true nodosarian.

It will be observed that, except for the rare microspheric examples of *Geinitzina triangularis*, our three species are rectilinear forms. Cushman and Waters had a similar association of such forms in their material from Sutton County. There can, therefore, be little doubt, as we have already suggested, that our species belong to the same genera as theirs. What, then, is the position of *Geinitzina* and *Spandelina*? Are they true Nodosariidae, and if not, what are their relationships?

The hyaline test, radiate aperture, and evidence of coiling in the microspheric form, of *Geinitzina triangularis,* point to an affinity with the Nodosariidae, in which family Spandel placed the genus.

Spandelina was grouped by Cushman and Waters with the Textulariidae because of the compression of the early stages in the microspheric form, and of the absence of evidence of any of the species having a coiled young stage. To understand the position of *Spandelina,* it is necessary to remember that, in the two latest



Geinitzina triangularis Chapm. and Howch.

1-3. Outlines of Form A, showing simple test and megasphere. × 33.
4. Outline of Form B (microspheric), showing ancestral openly coiled commencement. × 33.
4*a*. Early stage of same, more highly magnified. × 66.
5. Aperture of *G. triangularis.* × 33.
5*a*. Ditto, more highly magnified. × 44.

classifications of the foraminifera, those by Cushman (1933), and Galloway (1933), the primitive Nodosariidae are stated to be coiled forms. Galloway (1933, p. 232) says, "*Lenticulina* is the most primitive member of the family, from which, directly or indirectly, all the other genera of the family were derived." Cushman (1933, p. 175) is not so definite, but, after referring to *Robulus, Darbyella,* and *Planularia,* he goes on to remark, "From

these coiled forms there are several different genera developed." Of these later genera, we need mention only *Flabellina, Frondicularia, Dentalina, Nodosaria,* and *Lingulina.*

When the early geological history of the Nodosariidae is studied, we find in the Trias and Jurassic, an abundance of straight, curved, and partially uncoiled forms, many of which are ornamented with costae, while the closely coiled ones are fewer and of simple types of structure. This is particularly apparent in Terquem's memoirs on the foraminifera of the Lias (Terquem, 1858-1866). In the Permian, most of the species are rectilinear, with a few dentaline ones, but closely coiled forms have not been recorded from rocks of this epoch. The straight forms have been described under the generic names of *Frondicularia, Nodosaria, Spandelina, Spandelinoides, Geinitzina, Lingulina,* and *Orthocerina.* The predominance of such forms and the absence of closely coiled ones from known Permian faunas have undoubtedly contributed to the present understanding that these genera are not true Nodosariidae.

Brady (1876) and Spandel (1898) have figured dentaline forms from the Permian of Europe, and one of the present authors (W. J. P.) has recently met with both smooth and costate *Dentalinae,* of primitive types, in the Permian of Western Australia. We may also refer to the record of a curved nodosarian under the name of *Nodosaria* (*Dentalina*) *farcimen,* from the Carboniferous Limestone of England (Howchin, 1888, p. 11, pl. ix., fig. 21*a, b*). Except in the last-mentioned case, the dentaline forms occur together with the straight forms. As we now find the microspheric stage of *Geinitzina triangularis* to begin with a gently curved series of chambers, it seems that the straight forms were derived from curved forms. It is also suggested that all are species of the Nodosariidae, and that this family evolved, not from a closely coiled ancestor, but from a curved or openly coiled one. The closely coiled genera such as *Lenticulina* and *Robulus* are probably not primitive types, as has been thought, but a specialized development from an openly coiled one.

Since writing the above, we have received from Dr. J. Hofker a copy of his work on the foraminifera collected by Dr. Th. Mortensen during the Danish Expedition to the Kei Islands in 1922 (Hofker, 1933). On page 117 of this, we were much interested to read, in his notes on *Cristellaria costata* (Fichtel and Moll), the following: "The first chambers of the microspheric shells show the peculiarity of being arranged in a very slowly coiling spiral, not only in this species, but also in other ones of the genus *Cristellaria.* This characteristic points to the possibility that this genus might descend from a form closely related to *Nodosaria* or something like that (*Marginulina* ?). This would be in agreement with the fact that such genera are geologically older than *Cristellaria.*"

It appears to us, therefore, that *Spandelina* is one of the genera of the Nodosariidae, and that the flattened forms placed in it by authors are true *Frondicularіae*. Similarly we consider that the sub-genus *Spandelinoides* is inseparable from *Nodosaria*. We retain *Geinitzina* for the short forms of Frondicularian type with a slit-like aperture, for purposes of taxonomy, but it is clear from our Western Australian material that, in regard to any points of distinction between the original conception of *Geinitzina* and *Frondicularia*, the characters of transverse septation and median surface depression are not constant even in the one species, for different parts of the same test will show *Geinitzina*, *Geinitzina-Frondicularia* and *Frondicularia* phases. This variability is, as is well known, a special feature of the Nodosariidae, and has been responsible for much of the difficulty experienced by authors in satisfactorily separating the genera of the family.

Revised Names of Foraminifera recorded in "A Monograph of the Permocarboniferous Limestones of New South Wales." (Chapman & Howchin, 1905.)

Former Name.	Revised Name.
Nubecularia stephensi Howchin, p. 5, pl. i., figs. 1, 2; pl. iii., figs. 13, 14; pl. iv., figs. 1, 4.	*Calcitornella stephensi* (Howchin).
Pelosina hemisphaerica Chapman & Howchin, p. 6, pl. ii., figs. 2*a*, *b*.	*Pelosina hemisphaerica* Chapman & Howchin.
Hyperammina vagans Brady, p. 6. pl. ii., fig. 1.	*Tolypammina vagans* (Brady).
Haplophragmium agglutinans (d'Orb.) p. 7, pl. i., fig. 5.	*Ammobaculites* sp.
Haplophragmium emaciatum Brady, p. 7, pl. i., figs. 10*a*, *b*.	*Haplophragmoides neocomianus* (Chapman).
Haplophragmium pokolbiense Chapman & Howchin, p. 7, pl. i., fig. 6.	*Ammodiscus millettianus* Chapman.
Haplophragmium cf. *tenuimargo* Brady, p. 8, pl. i., fig. 11.	*Ammobaculites* ? *pseudospiralis* (Williamson) ?
Placopsilina tenuitesia Chapman & Howchin, p. 8, pl. iii., fig. 9.	*Placopsilina tenuitesta* Chapman & Howchin.
Lituola eristellarioides Chapman & Howchin, p. 9, pl. i., figs. 3, 4.	Not a foraminifer.
Lituola cf. *rhaetica* (Chapman), p. 9, pl. i., fig. 7; pl. iii., fig. 7.	*Ruditaxis* sp. cf. *rhaetica* (Chapman).
Thurammina papillata Brady, p. 9, pl. ii., fig. 13.	*Thurammina papillata* Brady.
Ammodiscus incertus (d'Orb.), p. 10, pl. ii., fig. 3.	Specimens not available for revision.
Ammodiscus millettianus Chapman, p. 10, pl. ii., fig. 3.	*Ammodiscus millettianus* Chapman.
Ammodiscus anceps (Brady), p. 11, pl. iii., fig. 1.	*Trochamminoides anceps* (Brady).
Ammodiscus ? sp., p. 11, pl. i., figs. 12*a-e*.	*Ammodiscus ovalis* Chapman.
Stacheia simulans Chapman & Howchin, p. 11, pl. ii., fig. 4.	Not a foraminifer.
Endothyra bowmani Phillips, p. 12, pl. i., figs. 13*a-e*.	*Endothyra* cf. *bowmani* Phillips.

Endothyra macella Brady, p. 12.	*Endothyra macella* Brady.
Monogenerina pyramidis Chapman & Howchin, p. 13, pl. iii., fig. 5.	*Nodosaria pyramidis* (Chapman & Howchin).
Valvulina bulloides Brady, p. 13, pl. i., figs. 9*a-c*.	*Globivalvulina bulloides* (Brady).
Bulimina affinis d'Orb, p. 14, pl. ii., fig. 7.	*Lingulina davidi*, sp. nov.
Pleurostomella ? antiqua Chapman & Howchin, p. 14, pl. ii., fig. 5.	*Nodosaria ? antiqua* (Chapman & Howchin).
Lagena acuta (Reuss), p. 14, pl. iii., fig. 10.	Not a foraminifer (Zooecium of polyzoan).
Nodosaria permiana (Spandel), p. 15, pl. ii., fig. 6.	*Nodosaria permiana* (Spandel).
Nodosaria (*Dentalina*) cf. *farcimen* (Reuss), p. 15, pl. ii., fig. 11.	Foraminifer, gen. et sp. indet.
Nodosaria (*Dentalina*) ? *bradyi* (Spandel), p. 15, pl. ii., fig. 12.	*Dentalina bradyi* Spandel.
Nodosaria (*Dentalina*) *labiata* (Spandel), p. 16, pl. iii., fig. 4.	*Nodosaria irwinensis* Howchin.
Frondicularia woodwardi Howchin, p. 16, pl. iii., fig. 2.	*Frondicularia woodwardi* Howchin.
Geinitzina triangularis Chapman & Howchin, p. 16, pl. ii., figs. 9 *a*, *b*, 10.	*Geinitzina triangularis* Chapman & Howchin.
Geinitzina postcarbonica Spandel, p. 17, pl. iv., fig. 3.	*G. triangularis* Chapman & Howchin.
Lunucammina cf. *permiana* Spandel, p. 17, pl. iii., figs, 6, 12.	Fig. 6, *Dentalina* sp. Fig. 12, Gen. et. sp. indet.
Marginulina cf. *breoni* (Terquem), p. 17, pl. iii., fig. 11.	*Dentalina* ? sp. indet.
Vaginulina cf. *legumen* (Linné), p. 18, pl. iii., fig. 8.	*Frondicularia* ? sp. indet.
Anomalina supracarbonica Chapman & Howchin, p. 18, pl. i., figs. 8*a-c*.	Specimen lost before revision undertaken.
Truncatulina haidingeri (d'Orb.), p. 18, pl. iii., figs. 3*a-c*.	*Ammodiscus planoconvexa*, sp. nov.

Systematic Notes on the Species.

Family NODOSARIIDAE.

Genus **Dentalina** d'Orbigny, 1826.

Dentalina bradyi Spandel.

Dentalina bradyi Spandel, 1901, p. 16, text-fig. 9.

Nodosaria (*Dentalina*) *bradyi* (Spandel)?; Chapman & Howchin, 1905, p. 15, pl. ii., fig. 12.

No further examples of this species have been met with.

Genus **Nodosaria** Lamarck, 1812.

Nodosaria irwinensis Howchin.

Nodosaria irwinensis Howchin, 1895, p. 196, pl. x., figs. 7, 8.

Nodosaria (*Dentalina*) *labiata* Chapman & Howchin,, (non *Dentalina labiata* Spandel), 1905, p. 16, pl. iii., fig. 4.

The only example available for the present revision is that figured from Pokolbin. This is now found to be very finely costate, and is identical with the species described by one of us

(W.H.) under the name of *Nodosaria irwinensis,* from the Permian of the Irwin River, in Western Australia. The same form is very common in beds of similar age in the Wooramel River district, also in that State. While generally perfectly straight, in a large series of specimens dentaline examples are usually met with. The aperture of *N. irwinensis* is circular, and situated at the base of a slight depression. Spandel's *Nodosaria striato-clavata,* from the Zechstein of Germany, is related to the present form.

NODOSARIA PYRAMIDIS (Chapman and Howchin).

Monogenerina pyramidis Chapman & Howchin, 1905, p. 13, pl. iii., fig. 5.

For reasons which are given earlier in our notes on *Monogenerina,* we now transfer this species to the genus *Nodosaria.* It is known only from thin sections, no free examples having been met with.

NODOSARIA (?) ANTIQUA (Chapman and Howchin)

Pleurostomella ? antiqua Chapman & Howchin, 1905, p. 14, pl. ii., fig. 5.

The present species was originally referred, with some slight reservation, to the genus *Pleurostomella,* to which it is now clear it certainly does not belong. The generic position of this form, which is represented by a unique example is, however, still doubtful. The first three or four chambers of the type specimen are laterally compressed; the next is circular in section, while the remaining chambers are flattened in a plane at right angles to that of the early portion of the test. The shell appears to have been crushed, and the apertural end has been broken away. The affinities of the species appear to lie with *Nodosaria,* to which genus, in the absence of better material, we doubtfully refer it.

Genus **Lingulina** d'Orbigny, 1826.

LINGULINA DAVIDI, sp. nov.

Bulimina affinis Chapman & Howchin (non d'Orbigny), 1905, p. 14, pl. ii., fig. 7.

Description.—Test rectilinear, sub-pyriform, slightly compressed, initial end acute, apertural end bluntly pointed; beginning with a small globular proloculum, followed by four or five chambers which increase rapidly in size as added, sutures distinct, slightly depressed in the later part of the shell; wall calcareous, perforate, aperture radiate.

Length of holotype (in collection of Department of Mines, Sydney) 0.62 mm.; longest diameter, 0.34 mm.; shortest diameter, 0.26 mm., from Permian of Wollong, New South Wales.

Remarks.—This species is apparently the same as that previously recorded under the name of *Bulimina affinis* d'Orbigny. The specimen then figured has unfortunately been lost during the

revision, and before it was thoroughly examined. The present specimen is a finer example which we have since picked out of the same sample, and we have no doubt it is the same species. The genus *Lingulina* has previously been recorded by Spandel from the Permian (Zechstein) of Germany.

We desire to associate the name of the late Professor Sir T. W. Edgeworth David, F.R.S., with this new form.*

Genus **Ammodiscus** Reuss, 1861.

Ammodiscus ovalis Chapman.

Ammodiscus ? sp. Chapman & Howchin, 1905, p. 11, pl. i., figs. 12 *a-c.*

Ammodiscus ovalis Chapman, 1913, p. 170, pl. xvi., figs. 5 *a, b.*

This species was originally doubtfully referred to the genus *Ammodiscus,* but we have obtained some additional examples which confirm its identification by one of us (F.C.) with *A. ovalis,* described later by him from the Kalimnan (Lower Pliocene) of the Mallee Bores.

Ammodiscus planoconvexa, sp. nov.

Truncatulina haidingeri Chapman & Howchin, (non *Rotalina haidingeri* d'Orb.), 1905, p. 18, pl. iii., figs. 3 *a-c.*

Description.—Test planoconvex, periphery sub-acute; proloculum large, tubular chamber increasing rather quickly in diameter, forming two to two and a half coils, obliquely flattened in section and on the convex side of the test overlapping the earlier coils; suture on flat side depressed; wall comparatively thick, composed of small sand grains, firmly cemented, surface not smoothly finished; aperture oblique, formed by the end of the tubular chamber.

Diameter, 0.77 mm.; thickness, 0.25 mm.

Holotype (Collection of Department of Mines, Sydney), from Pokolbin, New South Wales.

Remarks.—This is a very interesting well-defined species which connects *Ammodiscus* with *Trochammina,* having the form of the latter, but with the undivided tube of *Ammodiscus.* The figured specimen is the only one that has been found.

Genus **Tolypammina** Rhumbler 1895.

Tolypammina vagans (Brady).

Hyperammina vagans Brady, 1879, p. 33, pl. v., fig. 3. Chapman & Howchin, 1905, p. 6, pl. ii., fig. 1.

This species has not so far been met with elsewhere as a fossil in Australia. It has a long geological history, beginning at least as far back as the Carboniferous. The specimen figured from

* It is with deep regret that we record the decease of Sir Edgeworth, while this paper, in which he took a keen interest, was passing through the press.

Wollong resembles *T. confusa,* described by Galloway and Harlton (1928, p. 344, pl. xlv., fig. 5), as *Ammovertella ? confusa* from the Middle Pennsylvanian of Oklahoma, United States of America.

Genus **Calcitornella** Cushman and Waters, 1928.

Calcitornella stephensi (Howchin)

Cornuspira, sp. nov. Jones, 1882, p. 6.
Nubeculuria lucifuga Defrance var. *stephensi* Howchin, 1894, p. 345, pl. x*a*, xi*a*.
N. stephensi Howchin: Chapman & Howchin, 1905, p. 5, pl. i., figs. 1, 2; pl. iii., figs. 13, 14; pl. iv., figs. 1, 4. Etheridge, jnr., 1907, p. 13, pl. xii., fig. 11.

This species belongs to the genus *Calcitornella,* described in 1928 by Cushman and Waters from the Pennsylvanian and Permian of the United States of America. The only occurrences of the genus outside America with which we are acquainted are those given above, and it is of much interest to note that this generic type was met with by Professor Rupert Jones as long ago as 1882, when he recorded it from the Piper River beds in Tasmania as "a contorted porcellanous foraminifer (new species of *Cornuspira*)." *C. stephensi* is now known to occur in the Permian of New South Wales, Tasmania, Western Australia, and Northern Territory.

Genus **Trochamminoides** Cushman, 1910.

Trochamminoides anceps (Brady).

Trochammina anceps Brady, 1876, p. 76, pl. iii., figs. 8 *a, b.*
Ammodiscus anceps (Brady): Chapman & Howchin, 1905, p. 11, pl. iii., fig. 1.

Brady's description of this species indicates that it is referable to the genus *Trochamminoides,* the tubular chamber being merely constricted, and not truly septate. The example figured from Pokolbin is the only one available; it is very typical.

Genus **Haplophragmoides** Cushman, 1910.

Haplophragmoides neocomianus (Chapman).

Haplophragmium neocomianum Chapman, 1894, p. 695, pl. xxxiv., figs. 2 *a, b.*
Haplophragmium emaciatum Chapman & Howchin, (non H. B. Brady), 1905, p. 7, pl. i., figs. 10 *a, b.*

The specimens formerly recorded under the name of *Haplophragmium emaciatum* Brady, from Wollong, are thin and almost complanate, and are now referred to the present species, which they closely resemble. This was described from the Bargate Beds of Surrey, England.

Genus **Ammobaculites** Cushman, 1910.

AMMOBACULITES sp.

Haplophragmium agglutinans Chapman & Howchin (non *Spirolina agglutinans* d'Orbigny), 1905, p. 7, pl. i., fig. 5.

This species is represented by a single example, which, while referable to the genus *Ammobaculites*, differs from *A. agglutinans* in having a broader, less regular test, of quite different form. In the absence of better defined material, we hesitate to attach a name to it.

AMMOBACULITES ? PSEUDOSPIRALIS (Williamson) ?.

Haplophragmium cf. *tenuimargo* Chapman & Howchin (non Brady), 1905, p. 8, pl. i., fig. 11.

Only one example of this form is available, and a section is necessary to determine its generic position, hence we doubtfully refer it to the above genus and species, which it resembles more than *A. tenuimargo*.

Genus **Ruditaxis** Schubert, 1920.

RUDITAXIS sp. cf. RHAETICA (Chapman).

Lituola cf. *rhaetica* Chapman: Chapman & Howchin, 1905, p. 9, pl. i., fig. 7; pl. iii., fig. 7.

The present specimens are referable to Schubert's genus *Ruditaxis*. The range of this is given by Cushman in his latest classification as from Carboniferous to Permian, but it apparently extends into the Triassic, as *Lituola rhaetica* Chapman, from the Rhaetic of England, belongs to this genus.

Genus **Globivalvulina** Schubert, 1920.

GLOBIVALVULINA BULLOIDES (Brady).

Valvulina bulloides Brady, 1876, p. 89, pl. iv., figs. 12-15. Chapman & Howchin, 1905, p. 13, pl. i., figs. 9 *a-c*.

The only example is from Wollong, but is typical. The known range of this genus is Carboniferous to Permian.

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